PB-215 931

PUBLIC HEALTH PROBLEMS IN CIVIL DEFENSE: AN OUTLINE GUIDE COVERING SANITATION ASPECTS OF MASS EVACUATION

Public Health Service
Washington, D. C.

1956

DISTRIBUTED BY:

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National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

PB 215 931

Public Health Problems in Civil Defense

An Outline Guide covering Sanitation Aspects of Mass Evacuation

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

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NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

Public Health Problems in Civil Defense

An Outline Guide

covering

Sanitation Aspects of Mass Evacuation

Radioactive Fallout
Water
Sanitation of Food Service
Excreta Disposal
Refuse Management
Personal Hygiene
Disinfestation and Vermin Control

1956

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Bureau of State Services
Division of Sanitary Engineering Services

PUBLIC HEALTH SERVICE PUBLICATION NO. 498

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Prepared under Delegation of Authority No. 1 from the Federal Civil Defense Administration

Definitions

1. Evacuation: The organized, timed, and supervised dispersal of civilians from dangerous and potentially dangerous areas, and their reception and care in safer areas.

Evacuation may be of three types: *a. Strategic.*—During a period of international tension preceding actual warning, it may be desirable to move certain dependent, nonproductive people away from danger areas.

b. Tactical.—After warning that an attack is probable, time may permit the mass evacuation of people from target areas.

c. Remedial.—Following an attack, all persons not needed for civil-defense services may be evacuated.

2. Movement Process: The orderly or disorderly movement of population from a city by any means, including foot travel, and using any available route of egress.

This may be one or a combination of the following three types: *a. Assisted.*—In advance of attack warning, civil-defense authorities may decide to encourage and assist the voluntary movement of priority groups out of danger areas, so that essential workers in defense or production may remain at their posts knowing that their families are safe.

b. Directed.—After attack warning, civil-defense authorities may decide to move large segments of the population according to preattack evacuation plans.

c. Spontaneous.—Some parts of the population may feel it necessary, for self-preservation, to remove themselves as rapidly as possible from an area they consider dangerous. This movement will usually be unorganized and unsupervised.

3. Assembly Area: A predetermined and designated geographical area beyond the outer edge of the zone of expected light damage, and considered a safe distance from blast, heat, and initial radiation (the gamma rays and neutrons released instantaneously with the explosion). It will provide for the temporary assemblage of both evacuees and vehicles.

4. Reception Area: An area, including rural communities, where evacuees may be temporarily or permanently absorbed into the population.

5. Welfare Center: Any center (or subcenter) at which welfare services are rendered. Welfare services include mass care (emergency feeding, lodging, and clothing), registration of evacuees, and other assistance to people in need.

6. CBR Agents: Chemical, biological, or radioactive agents.

General Statement

In present-day warfare, the use of nuclear weapons can result in the wholesale destruction of cities. Housing facilities will be destroyed or made untenable. Primitive conditions will prevail. Individuals and family groups may be forced to depend upon their own resources for periods of time, and should be taught to be self-sufficient until some order is restored. Sanitary safeguards are mandatory, in order to reduce to a practical minimum preventable illness that may be transmitted by water, food, insect and rodent vectors, and radiation emitted from fallout particles.

The State Department of Health has the primary responsibility for protection of the health of the people within the State. In general, the State Health Officer has been appointed to head the civil-defense health services, under the direction of the State Civil Defense Director.

Civil defense is a joint responsibility of Federal, State, and local governments. Its success is dependent upon effective and coordinated planning at all of these levels. Some State and local health departments in potential target cities have not considered civil defense a pressing and current problem. Such thinking is dangerous.

Where cities are evacuated, adequate sanitation safeguards must be provided along evacuation routes and in reception areas. Communities in potential reception areas must know the total sanitation services available or providable, in order to determine how evacuees may be housed, fed, and cared for. State health departments should work now with State and local civil-defense organizations in predisaster planning and the conduct of test exercises to determine the adequacy of health and sanitation measures. The planners must consider sanitary measures which should be taken to reduce illness and loss of life among those who may be forced to evacuate an area under enemy attack. Every citizen will be involved in evacuating a city, in assisting evacuees or in contributing to support efforts.

The facilities to which people may be evacuated include the usual transient accommodations—private homes in reception areas, structures adjacent to houses in rural areas, public buildings, industrial storage facilities, and exposed areas. The need for pre-selection of sites for assembly and reception areas is obvious; it will facilitate direction of evacuees to reception areas and assignment of service personnel to welfare and health duties. The time during which reception-area facilities may be used may extend over an initial emergency period of a day or a month to semipermanent occupancies of a year or more.

The area in which such evacuation facilities may be required will depend on routes of egress by rail, water, and highway; topographical features, weather, possible overlap from proximal target areas, and radioactive-fallout patterns. Dispersal areas may extend 100 to 500 miles from the target. Evacuation in subfreezing weather will add to the burden of welfare, health, and medical-care services.

Items of sanitation which must be considered for primitive conditions and emergency operations include safety and adequacy of water supplies, food, and shelter, together with necessary provisions for emergency disposal of body wastes and organic debris. Semipermanent occupancy requires consideration of additional measures designed for comfort, personal hygiene, and mental well-being. Because of the primitive conditions which would exist, the possibility of vermin infestation of body, clothing, and sleeping accommodations must be considered.

Mass evacuation deals specifically with the movement of total population. That movement involves the following services: warning and communications, engineering, transportation, police, health and radiation monitoring, welfare, warden, and supply.

The objectives of a comprehensive study of mass-evacuation sanitation are:

1. To determine where people can go to be safe from serious doses of radiation;

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2. To determine the sanitary measures that must be taken to protect the evacuee in movement, in temporary shelter, and until return to a permanent residence;

3. To ascertain the influence of sanitation requirements on operations conducted by other interests; and

4. To establish an effective plan for coordination of sanitation operations with those of other services.

It is the purpose of this study to examine carefully the sanitation practices which must be applied to mass evacuation in order to provide protection for both the evacuees and the existing population in reception areas, and in order to facilitate the operation of other services during the period of mass evacuation.

In the conduct of this study, the following assumptions are made:

1. Basic sanitation is essential to the maintenance of health in surviving populations.

2. Under the conditions existing after an attack neither normal equipment nor supplies will be available in adequate amounts; consequently, improvised facilities must be used and substitution of supplies may be necessary. In short, the sanitation standards applicable to normal living will not apply.

3. Thermonuclear weapons will be used.

4. Use of CBR agents may force substantial evacuation of target areas.

5. The time preceding actual attack may permit the orderly exodus of some portion of the population of the target areas.

6. Immediately following attack on a city, a disorderly exodus can be expected.

7. Appropriate State agencies must have preselected sites for assembly and reception areas, so that refugees will have a known destination. This will permit more rapid movement of evacuees, and planning for effective use of civil-defense personnel.

8. Radioactive-fallout particles may deny use of transit routes or reception areas, and may necessitate delays or use of alternate routes, or require further evacuation.

9. Orderly removal of persons from the attacked city may follow assessment of damage and relative radiation hazards and determination of need for care and shelter of surviving population.

10. State and local health departments will recognize that their responsibility for maintenance of a sanitary environment will be increased during the civil-defense emergency.

11. State and local government agencies will have planned for the effective integration and use of sanitary engineers and sanitarians in the civil-defense program.

At the time of need, even the most carefully developed plans for sanitation safeguards will undergo hasty and impromptu changes. An orderly and somewhat concise presentation of a planning concept may offer material assistance in reducing the magnitude of changes during a period of initial confusion.

Some proportion of urban populations will evacuate to areas up to 500 miles from the target city. The initial evacuation movement is envisioned as taking place from 2 hours or more prior to attack to 36 hours or more thereafter.

Sanitation problems (including those associated with radioactive fallout) attending the population movement can be separated into those occurring during transit, at assembly areas, and in reception areas. An expanded outline on the sanitation aspects of mass evacuation follows:

Radioactive Fallout

I. Situation

A. The detonation of a thermonuclear weapon produces a fireball that touches the earth, causing thousands of tons of atomized earth particles to be sucked 50,000 to 100,000 feet or more into the air. Contamination of large areas, on the order of 200 miles or more downwind from the bomb burst, may result from the fallout of radioactive particles or debris.

B. Meteorological conditions cannot be predicted in advance with sufficient accuracy to permit final determination of evacuation routes. However, following an alert or bomb burst, such predictions can assist in establishing evacuation routes.

C. Since fallout patterns cannot be accurately predetermined, all evacuation plans should be flexible, in order to permit further evacuation of individuals in reception areas who cannot find shelter for protection from radiation effects.

D. Rain or snow falling through the radioactive cloud will create a more serious fallout hazard in the areas of precipitation.

E. It will be necessary to utilize the services of trained monitoring teams in evacuation planning in fallout areas after the bomb burst, to delimit areas to be further evacuated.

F. An underwater explosion would have far less thermal and blast effect than an air burst, and serious fallout would be confined to the immediate target area, which would be blanketed with long-life, highly radioactive particles.

II. Plans

A. ***In movement.***—1. In the evacuation of cities, distance from ground zero is the prime objective. Traffic must flow steadily outward, in order to move all evacuees rapidly out of the danger zone of thermal and blast effects. Attempts to hold up traffic until radioactive-fallout patterns are determined may prevent evacuees from leaving the target city. Assembly areas generally should be located 10 to 20 miles beyond the outer edge of the zone of light damage of the target city.

2. Accurate evaluation of fallout areas can be made by trained radiological-defense personnel only after the bomb blast. Winds at altitudes of 25 to 60 thousand feet carry the major portion of debris from the bomb blast. The farther evacuees have traveled from the target city, the more time they will have to seek shelter or to re-evacuate laterally from the danger zone.

B. ***In reception areas.***—1. All reception areas should plan for fallout, recognizing that quick measures may be necessary for a few hours or a few days in order to protect the evacuees. The protection of evacuees and residents would require either immediate shelter which will shield them from radiation, or further lateral evacuation to less dangerous areas. Warning systems established by trained monitors can be used to alert appropriate civil-defense agencies.

2. From results obtained in firing a thermonuclear weapon, we may expect radioactive fallout in a zone extending on the order of 200 miles or more downwind, 20 miles upwind, and from 20 to 40 miles or more in width, where radiation doses may be fatal to unprotected persons. Lighter radioactive particles that are carried by the upper winds may be transported for weeks or months, and are not cause for immediate concern. Rain and snow can greatly change the fallout pattern. Raindrops fall fast, and may become contaminated with large amounts of radioactive material which will be deposited quickly in the area. Continued heavy rainfall conceivably, on the other hand, would assist in washing out radioactive debris into natural watercourses, thus reducing contamination. As an atomic cloud moves into a rain area, radiological-defense personnel will need to determine where new hazards develop and to alert those responsible for evacuation planning and the protection of residents.

3. Any type of cover or lodging can reduce, to some extent at least, the effect of radiation. The first floor of a barn or frame house will afford some

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protection, and probably will reduce the exposure by one-half, or even up to 90 percent if there is a basement. A basement with masonry wall and earth-fill backing usually can be expected to give adequate protection. The storm cellar commonly found in the tornado belt of the midwest, with its 3 feet of earth covering, will give virtually complete protection from fallout. Since it may be necessary for evacuees to remain in shelters from a few days to weeks, plans should include arrangements for supplies of food, water, clothing, waste disposal, and a radio. It is expected that people will be able to emerge from cover for brief periods to obtain emergency supplies without incurring serious radiation damage.

4. While the radioactivity of fallout particles initially decreases very rapidly and may be reduced 95 percent or more by the end of 2 days, only by careful monitoring can the nature and extent of danger be determined. After 48 hours, the remaining radioactivity is due to longer-lived particles. These particles are particularly dangerous if ingested in water or food. Recommended precautions to be observed with regard to contaminated food and water have been included separately in this guide.

5. There are certain essential facilities which may require decontamination, such as streets and highways, billets, waterworks, control centers, food establishments, medical-care facilities, and essential equipment; these are discussed in separate civil-defense bulletins. Decontamination measures for water and food have been included briefly in separate sections of this report. Decontamination of the evacuee is of particular importance, since radioactive dust falling on the clothing, hair, and skin of the individual increases his total dose of radiation. Suggestions for personnel-decontamination measures have been included in other sections of this guide.

6. Fallout particles tend to adhere to vehicles traveling through fallout areas, making them highly radioactive. Decontamination facilities for cars, buses, and trucks must be provided in receiving areas, with special teams selected for the job. Hosing off with water and the use of a detergent on parts where oil and grease tend to collect will remove much of the entrapped material. A good detergent may be required to remove all of it. Washwater should be discharged to an earthen pit, fenced and posted as "off limits to the public," to permit natural decay to reduce radioactivity to a safe level.

7. Cars and buses traveling through fallout areas will protect the evacuee from some external radiation.

C. *Informational programs.*—The evacuee can largely protect himself from radioactive fallout by applying a few simple protective measures. It is essential, therefore, that the public be informed how to apply lifesaving measures effectively and to understand instructions given in pre- and post-attack periods. Individuals should know –

1. How to recognize the best available shelter, and how to find the best-protected location in it;

2. Methods for decontamination of clothing and exposed parts of the body;

3. Measures for decontamination of packaged foods;

4. How to receive and follow civil-defense instructions;

5. That local radio stations will broadcast instructions on the special "Conelrad" wave lengths.

(Sanitarians should know how to monitor radiation, and the precautions to be taken in the disposal of any liquid or solid radioactive waste or refuse.)

Water Supply

I. Situation

A. Water will be required in movement, and at assembly areas and reception areas.

B. Water supplies along evacuation routes and in receiving areas will be overtaxed. Every source of water, including ponds, lakes, springs, and wells may be used.

C. Both evacuees and resident population of receiving areas will be exposed to the hazards of water contaminated by chemical, biological, or radioactive agents, or a combination of them.

II. Plans

A. ***Estimated water requirements.***—1. *Movement.*—Promote assembly of individual survival kits. These should include at least 1 gallon of water per person. Only those leaving from home will have the opportunity of taking such a kit with them. Potable water in cans may be stored in automobile trunk compartments to hold a minimum of about 2½ gallons. Consideration could also be given to obtaining tablets or ampoules for water sterilization. It is also recommended that office employees and factory workers provide, at their place of work, several days' supply of water-sterilization tablets for transit use.

2. *Assembly areas.*—*a.* With controlled public supply or other suitable sources:

(1) Medical and first aid: 10 to 25 gallons per patient per day.

(2) Mass-feeding operation: 15 gallons per capita per day.

(3) Temporary shelters: 1 quart per ration with total of 1 gallon per capita per day.

b. With noncontrolled public supply:

(1) Posting of "*Conserve Water*" signs.

(2) Anticipated use of at least 20 to 25 gallons per capita per day.

3. *Reception areas.*—*a.* Temporary lodging in private homes.

(1) All means should be taken to promote the voluntary conservation of water.

b. Temporary lodging in other facilities.

(1) Minimum supply should be 1 gallon per capita per day, preferably 5 gallons per capita per day.

(2) Expected use of piped water in tent cities, about 5 to 20 gallons per capita per day.

c. Semipermanent lodging in communities.

(1) Expansion, supplementation, or both, of community water-supply facilities to meet increased demand.

d. Housing in semipermanent reception facilities.

(1) Provision of pressure water systems equivalent to public water systems insofar as sanitation safeguards are concerned.

B. ***Advance planning to meet requirements of an evacuation.***

The need for adequate pre-planning to select communities in reception areas and evaluate water-supply capacity and requirements is urgent. The maximum output of the water system will largely determine the number of evacuees a city can readily accommodate.

1. *For all locations—Collection of data and information.*

a. Complete physical inventory of all existing water supplies is necessary, including location, maximum capacity, and probable potability and safety under conditions of maximum use.

(1) Public, industrial, and privately developed water supplies, and undeveloped sources, such as wells, ponds, lakes, and springs.

(*a*) Surface-water supplies that normally are adequately protected must be assumed to be unprotected when evacuees are admitted to the watershed.

(*b*) Water from properly constructed wells and springs can be considered potable.

b. Investigation to determine development requirements for emergency use of undeveloped water supplies and to determine added protection requirements of developed supplies.

c. Investigation and inventory of resources of emergency water-supply equipment, including electric and motor-driven pumps, handpumps,

well points, tank trucks, mobile and improvised filters, storage tanks, drilling equipment, quick-coupling pipe, and chemicals.

d. Investigation of probable locations for evacuee campsites, with reference to available water.

2. *For all locations—Minimum protection and treatment criteria.*

a. All surface-water supplies, regardless of source, will require chlorination, treatment with iodine compounds (such as globaline, potadine, or hexadine–N), boiling, or some other acceptable disinfection.

(1) Bacteriological safety can be obtained with chlorination of reasonably clear waters at such a rate that, 30 minutes after dosing, there will be a free-chlorine residual of not less than 5 parts per million. Where biological warfare can be discounted, or where treatment by flocculation, sedimentation, and filtration immediately precedes the emergency application of chlorine, the dosing rate may be reduced so that the 30-minute residual will be not less than 2 parts per million.

(2) Boil for 1 minute.

b. Removal of debris by means of mechanical straining or filtration.

(1) Vary from improvised strainers to modern water-treatment equipment.

c. Avoid malodorous, highly colored, or highly polluted water.

3. *Additional criteria for assembly areas.—a.* Water should be taken from public supply, if available.

b. Water taken from undeveloped sources, such as wells and springs, should be reasonably clean and free from excessive odor, taste, and turbidity.

c. For undeveloped water resources, disinfection of the supply must be accomplished before use.

(1) Chlorinate, if chlorine is available, using dosage of 10 p. p. m.; or

(2) Boil for 1 minute; or

(3) Treat with iodine-compound tablets; or

(4) Other acceptable disinfection.

d. Generally, no laboratory supervision should be attempted for water supplies used during this emergency period of the first 3 days.

4. *Additional criteria for reception areas.—a.* The membrane filter may be used for a rapid, accurate test for the enumeration of coliform bacteria.

b. For reception areas not serviced by public water supplies, the standards applicable to emergency public water supplies should be maintained as recommended by the State department of health.

III. Water-conservation requirements

It is obvious that there will be a need for conservation of water until such time as adjustments can be made to meet increased demands.

A. ***Assembly areas.***—Assembly-area water supplies may be emergency in character, and strictest conservation must be practiced at all established water-distribution points.

B. ***Reception areas.***—It is anticipated that community water supplies will be called upon to meet demands considerably over normal. To meet such demands, either the water supply must be rationed at the source, the per capita consumption must be reduced, or the number of people using the supply must be limited. Possible control measures include:

1. Restriction in use of water by nonessential consumer services.

2. Development of a voluntary reduction in consumption by conducting a comprehensive public-educational program designed to elicit the maximum cooperation. A limited water supply may, by careful rationing, be made to cover all of the uses during the emergency period, while at the same time maintaining reasonable sanitary safeguards.

a. The educational program may be supplemented by some small amount of monitoring by volunteers.

b. This voluntary conservation will not be fully effective without some enforcement of restrictions.

3. Pre-establishment of a planned program of restricted water use for purposes other than sanitary, drinking, medical and hospital, culinary, essential industry, and disaster operation, backed up by both voluntary monitoring and official enforcement.

4. Increase of water production to the maximum, with continuation of normal water usage for the community population, plus such evacuee population as can be absorbed. Example: A community with a source of supply that is unlimited may expand its water service so that quantity of water is not a limiting factor in the housing of evacuees.

IV. Essential services

The following are considered to be essential water-consumer services in time of emergency.

A. Medical-care facilities, including temporary or permanent hospitals and field first-aid stations. Where possible, field hospitals and first-aid stations should be located near adequate water supplies.

B. All mass-feeding operations.

C. All industrial operations specified as essential.

D. All commercial operations furnishing supplies or equipment specified as essential.

E. All decontamination uses requiring water.

F. Minimal supply of water for individual consumer use.

G. Fire protection.

V. Problems of operation and protection in reception areas

Although water-supply systems in these areas may be adequate for normal operations, many problems arise when these same systems will be forced to operate at maximum output for 30 days or more, and the operators must plan in advance for materials, supplies, and equipment required for such operation. Following are items requiring consideration as part of a plan for absorbing refugees in receiving areas.

A. *Problems of operation.*

1. *Systems used for public water supply.—a.* Examination of mechanical ability of equipment to operate at maximum capacity.

b. Establishment of plan for rigid preventive-maintenance program to be placed in effect during emergency.

c. Determination of types of chemicals required for plant operation during emergency.

d. Plan for procurement of chemicals, supplies, and spare parts needed (above normal requirements) from more than one procurement source. (See FCDA Manual TM–13–2.)

e. Plan for changes in operation required due to nonavailability of needed chemicals, supplies, and spare parts at time of emergency.

f. Plan for personnel required to operate under emergency conditions.

g. Provide an auxiliary source of power.

2. *Individual and farm water systems and undeveloped sources.—a.* Systems which appear likely to be used on an expanded basis for servicing evacuee assembly and reception areas should be studied for needs, as provided in the foregoing section, "Systems used for public water supply." While final planning for such centers is impossible until the exact location and population have been determined, tentative plans should be developed for material, equipment, and supply needs for typical centers of 100, 500, 1,000, and larger population.

b. Although most assembly and reception areas should be preselected, many may have to be developed as evacuation progresses. Water supplies which service such centers, and which are obtained from individual and farm water supplies and from undeveloped sources, must be examined on the spot, and minimum sanitary safeguards instituted. Typical plans should be developed for providing temporary water supplies from ground or surface sources for encampments of 50, 100, 500, and 1,000 persons.

Where surface-water sources must be developed, FCDA (and other governmental agencies) have stockpiled a number of 100-gpm, portable, water-filtration units at strategic sites, which may be requisitioned for emergency use. Portable filtration units which have been designed for meeting water requirements of a field hospital will require operators trained in water-plant operation and maintenance. Care must be exercised in the treatment of turbid waters, since adequate pretreatment before filtration must be carried out. It is preferable to select clear-water streams and lakes for portable-plant water sources.

(1) Tentative schedules should be established for materials, equipment, supplies, and personnel required to safeguard and operate such systems.

(*a*) Emergency chlorination.

(*b*) Removal of extraneous matter and excessive suspended materials.

(*c*) Construction and installation of temporary system.

(*d*) Operation of system.

(*e*) Rationing of water.

(2) Water may be hauled to shelter areas by tank truck. A 1,000-gallon tank truck, with a storage tank at the site, should be able to provide water for 1,000 refugees.

B. *Protection.*—

1. *Physical protection.*—It must be recognized that water is probably the most important single need of individuals in time of stress. It is re-

quired for satisfaction of physiological needs, and it is essential that evacuees be assured that water is available. Without that assurance, morale is lowered, hysteria may develop, and panic is possible. Under circumstances surrounding evacuation, physical protection of the water supply to be used by evacuees becomes a major consideration. In addition to such barriers as may already exist, physical guarding may be necessary to prevent mobs from overrunning and damaging treatment plants, pumping stations, tank trucks, distribution stations, and temporary collection facilities. The character and extent of such guarding is a matter contingent upon the local situation.

2. *Protection against CBR agents.*—Supplies may unexpectedly be made nonpotable by the intentional or unintentional introduction of a CBR agent, or by contamination from fallout or absorption of such material. Procedures to be followed in the event that such agents are suspected will be determined by sanitation personnel trained in the detection of such agents. Supplies suspected of exposure shall not be used until declared safe. Currently, there are no methods for rapid determination of BW agents. If the water supply is suspected, vigorous boiling or maintenance of 5-ppm free-chlorine residual probably will make it safe. Personnel in areas in which public water supplies have been rendered unsafe because of radioactive fallout may need to transport water from outside the fallout area and set up central watering points for the needs of the evacuees and residents. Specific recommendations have been developed for protection of public water supplies against CBR agents, as follows:

a. Establishment of effective liaison between water-quality laboratories and specialized bacteriological, viral, and toxicological laboratory services, through official civil-defense agencies.

b. Strengthening of chlorination measures and continued observation of chlorine residuals in the distribution system.

c. Location of dependable, safe, and easily protected auxiliary sources of drinking water for use if sabotage of the public supply is suspected and if decontamination may not be applied with confidence to water from mains.

3. *In fallout areas.*—It must be recognized that the radioactive material remaining after the external radiation has decreased sufficiently to permit reoccupancy of an area will be long-lived, and that the amount remaining in exposed water at that time may still be sufficient to constitute an internal radiation hazard. For this reason, such sources of water should be assayed for this hazard before being used for domestic purposes. Radioactive fallout may affect certain areas of the watershed of a surface supply located downstream and outside of the fallout area. Sanitation personnel should, therefore, be requested to assess the radiation hazard at intervals, daily, until the danger has passed. Wells with properly constructed curbs probably will be adequately protected from fallout particles.

Sanitation of Food Service

I. Situation

A. Food will be required in assembly and reception areas.

B. Normal foodstocks will be depleted in reception areas.

C. All sources of food suitable for human consumption will be needed.

D. The use of food produced, stored, and transported under insanitary conditions can be anticipated.

E. Food of questionable quality for human consumption may be preempted by those in dire need.

F. Normal food-sanitation safeguards will be difficult, if not impossible, to maintain.

G. Both evacuees and resident populations will be exposed to the hazards of foodborne-disease outbreaks.

H. Normal sources of food may be denied or made unsafe for use because of contamination by CBR agents or by radioactive-fallout particles.

II. Plans

A. *Food requirements for evacuation*

The establishment of quantities, types of food, and lines of supply are not the responsibility of the health authorities. However, the quantities, types of food, lines of supply, and means of distribution must be made known to health officials in order that emergency sanitary safeguards may be devised. The first move in planning, therefore, is the interchange of knowledge among health, supply, and welfare authorities, and others who may be involved in food supply, so that a reasonable plan for sanitary supervision of food facilities can be developed. It should be recognized that there are two distinct situations to be considered:

(1) That of emergency food supply for those who still maintain facilities for food preparation; and

(2) The problem of mass feeding of populations without such facilities.

B. *Planning to meet sanitation requirements.*

1. *Movement.*—Evacuees will largely be dependent upon their own resources. Planning should include an educational program designed to emphasize the need for all evacuees to equip themselves with an emergency supply of food and water, sufficient to last a period of 3 or more days.

2. *Assembly areas.*—*a.* Health, welfare, and other agencies concerned should establish a definite plan for assembly-area feeding. If evacuees do not have survival kits upon arrival at assembly areas, it may be possible to provide them with kits or K-rations at this time. Such kits would induce a minimum of sanitary hazards, since they would have been packaged under normal, sanitary conditions.

b. Among the food-dispensing facilities requiring sanitary supervision, there are likely to be emergency field kitchens for field hospitals and first-aid stations. Firm, but flexible, plans should be made for the organization of sanitation squads, drawn from either local personnel or evacuee personnel. Squad leaders should be held responsible for supervision of kitchen sanitation, including surveillance of food storage and preparation and kitchen housekeeping.

3. *Reception areas.*—*a.* Food-sanitation operations in reception areas should be concerned with feeding at emergency and field hospitals, mass feeding, and protection of food supplies which are to be used directly by evacuees and residents.

b. In reception areas, it becomes necessary to develop food supplies which are more substantial in character and more specific in needs than while populations are in transit. Accordingly, consideration must be given to the safety of greater quantities and varieties of food. One of the specialty requirements which must be given first priority is the provision of a safe supply of milk. If canned milk or prepackaged milk powders are provided, they must be reconstituted under sanitary conditions. If fluid raw milk is available for infants and hospital patients, the milk must be

made safe by boiling. The use of foods usually connected with foodborne diseases should be discouraged. Menus should be planned that do not require large quantities of food to be refrigerated. Meals should be plain but nourishing, with no attempt to provide particular foods for individual taste.

c. Sanitation squads should be formed in reception areas in the same manner and for the same purposes as were described under assembly areas, except that the squads will be more permanent in nature and will need to have more training. It is anticipated that, in reception areas, professionally trained sanitation personnel, resident in the receiving area or brought in from target areas or areas unaffected by the emergency, will be available. Personnel having special training in food sanitation should assume overall direction of specific food-sanitation programs, whereby production, transportation, storage, and distribution receive basic surveillance. Such a program should include:

(1) Supervision of milk sanitation.

(2) Examination for contamination and spoilage of all food supplies received.

(3) Supervision of food-storage conditions that will minimize contamination and deterioration.

(4) Supervision of sanitation practices associated with mass feeding, including food preparation, serving, housekeeping, and removal of waste.

(5) Supervision of the utensil and dishwashing facilities and operations.

(6) Instruction to food-service personnel in proper sanitary practices appropriate to the improvised facilities which are likely to be in use. It should be borne in mind, in planning for such training, that hot- and cold-water supplies may be inadequate, and that dishwashing facilities will be minimal in character, such as barrels or tubs. Cooking facilities may be improvised, such as steel-plate griddle, double-barrel oven, or cross-fire trench. In general, it must be recognized that sanitary hazards will be increased with the use of improvised facilities.

(7) Attention should be given to coordinated planning of location and layout of mass-feeding facilities. Such facilities, acceptable to welfare and medical services, should be capable of being maintained with reasonable sanitary safeguards. While the final selection of mass-feeding facilities may occur only as evacuation progresses, typical plans should be made for units capable of serving 25, 50, 100, 500, and 1,000 persons.

Tentative schedules should be established for materials, supplies, equipment, and personnel required to safeguard operations. Sources of supply for disinfectants, chemicals, detergents, brooms, mops, and other housekeeping supplies should be worked out in advance for such units. In addition, minimal quantities of supplies should be estimated for serving individual families occupying quarters, whether at organized camps or in private homes.

d. The introduction of evacuee families into private homes in reception areas offers many advantages. The hazards of foodborne disease will be reduced, the amount of sanitary supervision required will be decreased, and the general level of food sanitation of the community should not be materially changed. It is possible that the food-preparation and -service facilities of individual dwelling units will not be a limiting factor on the number of evacuees that can be absorbed by a community for limited periods of time. Maximum use should also be made of facilities at schools, churches, and lodge halls with equipped kitchens.

III. Protection

A. *Physical protection.*

It is essential that evacuees be assured that a safe supply of food is available. Therefore, physical protection in guarding foodstores may be necessary to protect food from unnecessary waste, contamination, and destruction.

B. *Protection from CBR agents.*

1. Supplies unexpectedly may be made unsafe by the introduction of a CBR agent. Procedures to be followed in the event that CBR agents are suspected will be determined by sanitation personnel trained in the detection of CBR agents. Supplies suspected of exposure shall not be used until declared safe.

2. Many foods which have been exposed to radioactive fallout can be consumed. Foods in sealed containers may be used if the container is washed or wiped off before opening. Foods having an outer layer that is or can be removed before eating (such as apples, potatoes, and bananas) should simply be washed or wiped off and peeled before use. It is possible, also, to remove significant radioactive deposit from other foods, such as leafy vegetables, simply by removing and discarding outer leaves.

Excreta Disposal

I. Situation

A. Circumstances surrounding the evacuation of cities are such that the discharge of body waste is concentrated along routes of travel and in areas where the facilities for the safe discharge of wastes are either entirely absent or grossly inadequate. Failure to handle such discharges adequately may result in—

1. An exposure of watersheds to gross contamination;

2. The development of odors;

3. The proper habitat for the rapid expansion of fly population; and

4. General deterioration of the sanitary environment along the routes of travel and in assembly and reception areas.

B. The existing community facilities for treating sewage will be affected. The quality of effluent may deteriorate because of the strength of the sewage or the overloading of treatment-plant facilities and, in some cases, the sewerage system may prove inadequate, in whole or in part, to handle the imposed flow.

C. Because of the possible deterioration of the sanitary safeguards of the environment, the hazards of disease are multiplied and, unless adequate controls are instituted, increases in the disease incidence associated with low standards of sanitation may be anticipated. Enteric diseases become a particular menace under these circumstances.

II. Plans.

A. ***Disposal requirements.***

1. *In movement.*—It will be physically impossible to police the routes of egress so that the discharge of human wastes can be confined to facilities provided for the purpose. The danger arises from the concentration of wastes from continued use of the same area by many persons as they pass along in transit.

2. *Assembly areas.*—*a.* Provision should be made for toilet facilities at the rate of 1 urinal and 12 seats per 100 evacuees. If the sewerage system cannot handle the additional load, provision should be made for temporary latrines to accommodate the population.

b. Where private sewerage systems (septic tanks) are overloaded by the influx of evacuees, latrines or slit trenches should be provided. They should be installed on the basis described in the preceding paragraph.

3. *Reception areas.*—*a.* At encampments, minimum toilet-facility requirements should include 1 urinal and 5 to 8 toilets per 100 men, and 5 to 12 toilets per 100 women.

b. Disposal of excreta from facilities in private homes will depend upon the adequacy of the water supply and sewerage systems to handle the increased load from evacuees. Where strict curtailment of water is required, emergency home waste-disposal measures must be instituted or communal latrine facilities erected.

c. Consideration must be given to provision of appropriate emergency methods for the handling and disposal of wastes from improvised hospitals.

B. ***Advance planning to meet the requirements.***

1. *For all locations.*—After sites for assembly and reception areas have been tentatively selected, an inventory should be made of places suitable for the location of latrines. Determine the maximum number of facilities required and the quantity of sanitary supplies necessary to minimize odors, fly breeding, and other nuisances.

An investigation should be made of probable locations of evacuee campsites, with reference to the effect of excreta disposal on sanitation of the area, including the effect upon water supplies.

Plans should be made for sanitary squads, made up of evacuees or local residents, which would be responsible for policing and maintenance of all comfort-station facilities in public places, including those at watering points, campsites, and reception areas. Plans should be made for training sanitary squads in the use of cleaning methods and disinfectants appropriate for each facility.

Plans for the surveillance of excreta-disposal sanitation, under the general direction of professional sanitation personnel, should be coordinated with plans for the construction of sanitary facilities under the direction of public-works personnel.

2. *Planning for excreta disposal by individuals.*—Since the proper sanitary facilities will not always be available to people in movement and in assembly areas, it is essential that the public be educated in the proper method of disposal to be practiced by the individual. The essential requirement is the digging of an individual shallow hole of sufficient depth (6 to 8 inches), and covering excreta with earth. Complete removal of visible evidence of use will usually provide enough cover to protect against washing and erosion by rainwater, and will serve as an effective screen against flies.

3. *Additional planning for excreta-disposal facilities for communities.*—*a.* It should be obvious that, if people can be housed in existing dwelling units, there will be less opportunity for widespread pollution than if they must be sheltered in improvised housing.

b. It is essential to investigate the disposal facilities available at private homes to determine to what extent excreta-disposal facilities are a limiting factor on the number of occupants, to estimate the number of people who may be safely accommodated in the unit, and to determine what improvements or additions will be required to make full use of the housing facilities.

c. It is essential to examine the community sewerage systems in conjunction with the survey of community quarters. The sewer systems and treatment plants may be operating at capacity for the normal population, and the additional load imposed by evacuees may contribute to serious reduction in efficiency or failure of sewage works.

d. Water used for decontamination purposes may be highly radioactive and, thus, a dangerous hazard if discharged to a watercourse. Decontamination waste-water should be contained until natural decay reduces radioactivity to a permissible level. Precautions must be taken to protect the public from radioactive wastes held in tanks or basins.

III. Problems of operation and maintenance in reception areas

A. *Sewerage systems.*

It will be necessary to examine the system requirements at maximum use for 30 days or more, and to plan in advance for materials, supplies, equipment, and personnel required for such operation. Following are items that require examination as part of a plan for absorbing evacuees in a receiving area.

B. *Problems of operation and development.*

1. *Public systems.*—*a.* Examine mechanical operating capacity of machinery.

b. Plan a rigid program of preventive maintenance to be placed in effect during the emergency.

c. Determine types of chemicals that may be required for odor control or disinfection during emergency period.

d. Plan for procurement of supplies and spare parts needed above normal requirements.

e. Plan for changes in operation due to nonavailability of chemicals and supplies in time of emergency.

f. Plan for personnel required to operate and maintain systems under emergency conditions.

2. *Semipermanent systems for reception centers.*—Systems likely to be used on an expanded basis or installed as new systems for serving reception centers should be studied, as provided in the foregoing section. The exact needs cannot be known until locations and population are determined; however, a tentative plan should be developed or the design, operation, and maintenance of sewerage systems, and for material, equipment, and supply requirements for typical centers for populations of 100, 500, and 1,000.

This planning should consider all forms of sewage disposal and sewage treatment, such as septic tanks, cesspools, sanitary privies, sand or cinder filters, and the more conventional treatment systems if required. Since reception-center facilities will not be permanent, any form of treatment should be of simple construction and easily operated. The design plan should be the minimum required to provide essential sanitary safeguards, such as protection of water supply, prevention of insect breeding, and elimination of odors.

Management of Refuse

I. Situation

The evacuation of large numbers of people from urban to rural receiving areas will overtax facilities in communities with facilities for refuse collection and disposal, and will necessitate such facilities in communities where this service is not available.

II. Plans

Effective storage, collection, and disposal of refuse will assure or support the successful control of moquitoes, flies, and rodents. There is a significant relationship between the incidence of vectorborne disease and improper disposal of refuse. Refuse includes all solid wastes, such as garbage, ashes, rubbish, street cleanings, dead animals, and solid market and industrial wastes.

It is essential that at least minimum sanitary services be planned in rest and receiving areas, to prevent creation of health hazards and to assure the control of illness produced by insect and rodent vectors. Special precautions must be taken for the disposal of radioactive refuse.

A. *In movement.*

It is expected that there will be some problems with refuse along the evacuation routes, under the emergency conditions which will prevail. No organized method of handling this material is proposed, other than disposal by burning or burial where indicated.

B. *In assembly areas.*

Plans should be developed for the storage, collection, and disposal of refuse in these areas. Improvised facilities might include garbage pits for disposal of putrescible wastes, with disposal of combustible rubbish by burning.

C. *Reception areas.*

Complete refuse service will be required. Facilities should be planned for all communities in reception areas to accommodate the additional load from evacuees billeted in private homes, temporary camps, shelters, and field hospitals.

III. Storage of refuse

A. *In movement.*

The indiscriminate disposal of refuse by evacuees en route to assembly areas will be impossible to control. It may be necessary for roving sanitary squads to burn or bury accumulations of refuse if they should develop.

B. *Assembly areas.*

Suitable refuse containers and container-storage racks should be provided.

The type and size of container to be provided will be governed by the kind of material to be stored. Garbage cans should be made of heavier material than trash containers, and should be washable, of watertight construction, and provided with tight-fitting, overlapping covers. Their capacity may be from 10 to 30 gallons. Rubbish containers may vary from 30 to 50 gallons in capacity, and should be constructed so that material cannot leak through seams or be blown out through the top.

Storage racks for garbage and rubbish cans should be so constructed that neither they nor the cans can be overturned by dogs, and so that cans will be held from 18 to 24 inches above ground level, so as not to attract vermin.

C. *Reception areas.*

Garbage service largely will include augmenting present facilities, except in those communities and camps with no refuse services.

Containers and storage racks should conform to recommendations suggested for assembly areas. In some large evacuee food-service establishments, garbage houses may be constructed with facilities for the storage of full garbage cans in vermin-proof structures. Garbage houses should have concrete floors sloped to a sewer drain, and hot-water connections for can washing.

In all areas, garbage racks and garbage houses should be conveniently located, to facilitate collection. Curb or alley collection points should be considered, to reduce time and cost of service.

IV. Collection of refuse

Sanitarians should estimate or plan for certain requirements essential to a well-organized program. These will include estimates of quantities of garbage, frequency of collection, number and size of collection vehicles, personnel required, method of final disposal, and disposal site.

The average American community will produce about 8 cubic yards of refuse per 1,000 population per day. However, the quantity of garbage produced under emergency conditions is not known. A 12-cubic-yard, compactor-type, garbage truck with 3 employees (a driver and 2 helpers) could serve a city of 5,000 in peacetime, with 2 pickups per week, assuming that each truck will make 3 trips per day to the final disposal point. Compactor trucks are furnished in 9-, 12-, 16-, and 20-cubic-yard sizes. However, in an emergency, trucks of all types will be used.

V. Disposal of refuse

Refuse may be disposed of by burial by sanitary-landfill methods or by incineration.

A. *Sanitary landfill.*—For most communities where the haul from the city does not exceed 10 miles to a satisfactory disposal site, the sanitary landfill is the choice method of final disposal. In this method, refuse is deposited on land, compacted, and promptly covered (each day) with compacted earth to prevent health hazards. Compacting into the smallest practicable volume is done by a crawler-type tractor. There is no burning of material, thus avoiding smoke and odor nuisance. The trench method, the ramp or progressive-slope method, and the area method, or combinations of these, are used today in sanitary landfills.

1. In the trench method, cover material is obtained by excavating a trench. The refuse is then dumped into the trench and compacted. Then, earth cover is excavated from the adjacent trench.

2. In the progressive-slope method, cover material is obtained from the area just ahead of the working face of the landfill.

3. The area method is utilized when soil conditions in front of the fill do not permit tractor excavations, such as in low or swampy areas. Cover material must be brought in from another location.

4. If radioactive wastes are buried, the place of burial should be well marked as to pit location, depth of cover, and radiation hazard.

B. *Incineration.*—As an alternative to a sanitary fill, refuse may be incinerated. If incinerated, refuse with appreciable amounts of garbage will require fuel for combustion.

C. *In emergencies,* refuse may be hauled to a suitable dumpsite and burned, provided that the process is supervised. Even with a minimum of equipment, good housekeeping can be practiced. Cans should be mashed flat (to prevent their holding water in which mosquitoes could breed), and combustible refuse should be burned and covered to discourage fly breeding and attraction of rodents. Radioactive wastes should not be burned unless special incinerators are available.

D. *Animal bodies.*—The bodies of small animals, such as cats and dogs, may be quickly disposed of by incineration or burial. However, large carcasses, such as those of cows and horses, should be buried in pits deep enough to avoid the possibility of being exposed by dogs. All animal carcasses should be removed and disposed of before putrefaction makes them difficult to remove and an attraction to vermin.

E. *Emergency mortuary service* is the responsibility of the local civil-defense health service. For planning the organization of this facility, see bulletin AG-11-1, "Health Services and Special Weapons Defense," chapter 16.

Personal Hygiene

I. Situation

Evacuees seeking relief and cleanup facilities while in transit, or while lodging in reception areas, may find that the kind of sanitary facilities to which they have become accustomed are not available or are primitive. Persons who are forced to evacuate through areas contaminated with radioactive-fallout particles will require special attention for decontamination and protection in order to safeguard life. Under the foregoing conditions, refugees will find that:

A. ***Essentials for personal comfort***, such as proper ventilation, heating, lighting, bathing, laundry, change of clothing, and proper footwear, are difficult to obtain.

B. ***Personal cleanliness*** will be a problem, due to limited laundry and bathing facilities.

C. ***Vermin infestations*** can be expected if surveillance and control measures are not instituted.

II. Plans

A. ***In movement.***—Refinements in personal needs cannot be provided or considered in transit. Here, the prime objective will be essential decontamination with minimum impediment to progress away from the target city. To prevent disastrous roadblocks in evacuation, it may develop that the establishment of emergency decontamination stations may be necessary to treat those evacuees in contact with fallout particles.

Planning should include a program of public education, emphasizing the following:

1. The dangerous effects of exposure to radioactive fallout.

2. The procedure to be followed if exposed during transit.

3. The program of decontamination that can be expected once reception areas are reached.

4. The risk to themselves and to others when individuals stop en route for nonessential needs and thereby slow down the traffic movement from the city.

B. ***In assembly areas.***—The cleansing and decontamination of individuals at assembly areas should be considered on an emergency basis, priority being given as follows:

1. *Decontamination of those affected by fallout.*

a. Children and pregnant women.

b. Injured, ill, and relatively helpless.

c. Uninjured, but contaminated.

2. *Cleansing of injured.*—*a.* Children and pregnant women.

b. Injured and relatively helpless.

c. Others (ambulatory).

C. ***Reception areas.***

1. Once evacuees have reached reception areas, more attention must be given to the maintenance of personal hygiene. Cleanliness of person and clothing must be given priority, to hold the incipient hazards of contagion, infestation, infection of wounds, dermatitis, and other personal afflictions in check.

2. It is assumed that the injured and ill will receive the required medical care in field hospitals and first-aid stations, but sanitation facilities for personal cleanliness also will be needed.

3. It is assumed that welfare services, or other services responsible for personal needs, may provide shoes and clothing suitable for outdoor comfort, since evacuees may not be properly clothed for living under exposed conditions.

4. Planning for personal hygiene at welfare centers and subsequent places of evacuee residence becomes largely a matter of suitable public education as to the sharing of community facilities and the means of maintaining personal cleanliness, even under adverse conditions. The provision of adequate sanitation facilities, including laundry, washrooms, showers, disinfestation, and other cleanliness operations, will be required in all temporary shelters and camps.

Disinfestation and Vermin Control

I. Situation

Following a disaster, conditions immediately become favorable for a rapid increase in insect and rodent populations. In part, this may be due to a breakdown in sanitary services, such as the collection and disposal of garbage and refuse, and the subsequent creation of extensive breeding and harborage areas. The assembly and housing of large groups of people in temporary shelters and receiving areas under such conditions will expose evacuees to diseases borne by insects and rodents.

The opportunities and facilities for personal cleanliness will be minimal along routes of travel, primarily because such routes will be crowded, but also because the available facilities and supplies cannot be brought to the points of need in time to be particularly helpful. Persons en route may be dependent upon streams, ponds, springs, and similar places for emergency cleansing.

At reception areas, overcrowding must be considered as a problem of group hygiene. Carriers of infectious diseases and persons with vermin infestation will be placed in close association with evacuees free from infection, without the opportunity for prompt discovery, diagnosis, care, and treatment. This situation, superimposed on somewhat primitive sanitary facilities and sanitation services, creates potential health hazards demanding attention and action.

The general movement of evacuees into sparsely populated, rural receiving areas exposes them to endemic diseases. Exposure of evacuees to insects in unprotected encampments introduces the specific hazard of diseases of known endemicity, such as typhus, malaria, and plague. Flies, fleas, lice, mites, mosquitoes, ticks, and rodents are diverse vectors capable of rapid development in an uncontrolled reception-area environment.

The insect pests that will cause trouble, annoyance, and localized infection include chiggers, gnats, bedbugs, mosquitoes, and other pests. First-aid stations should not have an unnecessary burden thrust on them because of their activities.

In most rural areas, one or another of the poisonous weeds or blister-producing shrubs and vines may be found. Poison oak, poison ivy, and poison sumac are probably most widespread. Many urbanites may not recognize these hazards to which they will be exposed in reception areas.

In some areas, persons will be exposed to poisonous reptiles, spiders, and similar dangers. While these affect the individual specifically, their attack is demoralizing to a group already inclined to hysteria because of circumstances.

II. Plans

A. ***Protection requirements.***

1. *In movement and at assembly areas.*—Persons in transit will have to protect themselves. Advance instructions should be given concerning the importance of wearing clothing that will give adequate protection from the hazards of living out of doors. First-aid instruction in the self-treatment of bites, stings, and exposure to poisonous weeds, and other items of self-preservation should be planned for the specific hazards of the reception area into which mass movement will occur.

In target areas where the transit exposures are most serious, additions to the survival kit should be planned in advance. Supplementary items, such as mosquito repellent, may be planned for issuance at assembly areas where the mosquito exposure introduces a positive malaria or encephalitis hazard. One 2-ounce bottle of repellent per person should be adequate.

2. *Reception areas.*—Protection against mosquitoes will remain largely a matter of individual control. Under severe conditions, sanitation squads may be able to apply larvicides to breeding waters within 1 mile of shelters. The requirements will depend on the size of area to be covered, the equipment available, the larviciding agents to be used, and the seriousness of the hazards. Reception-area locations should be chosen from those having a minimum of mosquito breeding within a 1-mile radius.

Planning for group hygiene at reception centers should consider the probability of louse infestation. A DDT-dusting station should be provided for the treatment of incoming evacuees. Sanita-

tion squads selected from local personnel and supervised by professional sanitarians should be trained in personnel-dusting operations. At encampments of 500 persons or more, the disinfestation station should be a compactly planned unit, with suitable quarters for handling persons quickly and efficiently. This station should also be equipped for the emergency disinfestation of clothing, bed clothing, and living quarters, as part of the program planned for the control of fleas, lice, mites, mosquitoes, flies, roaches, bedbugs, and other insects. Squads operating from such stations should also be able to carry on the required programs at nearby encampments with too few residents to justify separate disinfestation units.

The problems of group hygiene in communities should not be materially different from those occurring in any overcrowded area. Planning should incorporate an expansion of services and activities in community sanitation, based on the number of persons who may be expected in the community. Additional personnel, supplies, and equipment may be required and should be anticipated in advance planning. Planning for group hygiene is closely interrelated with ecological environment and the specific needs of people. These aspects are discussed in the several parts of this guide under their appropriate headings. The aspects of group hygiene related to vermin control are developed more fully here as an aid to planning.

B. The following general plan for operation of an effective rodent and vector control program is suggested.

1. List of possible vectors and vectorborne diseases in receiving areas:

Vectors	*Disease*
a. Mosquitoes	Yellow fever. Malaria. Dengue. Virus encephalitis.
b. Houseflies	Amebiasis. Dysentery. Typhoid fever.
c. Rodents	Weil's disease. Salmonellosis. Parasitic worms.
(rodent mites)	Rickettsialpox.
(rodent fleas)	Bubonic plague. Murine typhus.

2. *Preliminary surveys.*—Surveys should be made in assembly areas, reception areas, and shelter areas to estimate the extent and concentration of insect and rodent harborages and breeding areas. Maps should be prepared to show breeding areas and other data, to indicate where control measures must be instituted.

a. Mosquito-breeding areas.—Production areas may be located by making larval collections and inspections. A suitable data sheet should be used to record pertinent information which can be plotted on a map.

Collection of adult mosquitoes by the use of suitable traps will show quantitative information on mosquito populations and the effectiveness of control measures instituted.

b. Fly-breeding areas.—Inspection should be made for fly breeding at all refuse dumpsites, animal yards, and shelters, where putrescible matter is permitted to accumulate; and at surface toilets and heaps of uncovered garbage, abattoir wastes, or any decaying organic material.

Control measures depend primarily upon the effective collection and disposal of human excrement and organic wastes. Climate and season of the year are important factors in evaluating the fly-breeding potential. Temperatures above 70° F. are conducive to rapidly increasing fly population. Other control measures include chemical treatment of breeding areas by spraying, and screening of homes and food establishments. Where experienced personnel are available, routine determination of fly densities may be made to serve as "checks" upon the effectiveness of control measures.

c. Rodent harborages.—A rodent-control program should include a preliminary survey to indicate the extent of rodent infestation, the probability of the occurrence of disease spread directly through contamination of food, the probability of the spread of rat-and-fleaborne or mouse-and-miteborne disease, the possible destruction of food and property, and the biting of persons in temporary shelters.

An effective program, therefore, requires recognition of the species to be controlled, and may include trapping, poisoning, dusting, ratproofing of buildings, removal of harborages, effective collection and disposal of garbage and refuse, and control of food supply.

III. Control measures required

A. ***An informational program*** should be in-

stituted to point out the necessity of avoiding promiscuous scattering of garbage and other wastes which might result in the increased breeding of insects and rodents.

B. ***In reception areas,*** a definite plan should be established for vermin control. Special teams may be organized for this purpose. Effective use should be made of professional exterminators among the evacuees, who might well supervise the program.

1. *Mosquito control.*—In areas where mosquito-borne diseases are endemic, initial control should be directed against adult mosquitoes, as well as against mosquito-breeding areas.

a. Adult control.—The interior surfaces of occupied dwellings, outbuildings, culverts, and other resting places should be sprayed with a formulation containing DDT, chlordane, or other suitable insecticide, applied with either hand or power equipment. Where large numbers of mosquitoes invade shelter areas, temporary relief may be obtained through the use of power space-sprayers.

b. Larviciding.—The method to be employed will depend upon the location, size, and accessibility of the mosquito-breeding area.

(1) Where breeding areas are accessible and of less than 10 acres, land-larviciding operations, using either hand or power equipment, will prove effective.

(2) For areas of 10 acres and more, land or water power-spraying equipment will prove more efficient. For extensive breeding areas, where control measures are urgent, the use of airplanes with spray equipment may be required.

2. *Fly control.*

a. Control by sanitation.—(1) The most effective method for the control of flies is the practice of sanitation in the community. This includes the sanitary storage, collection and disposal of organic wastes and human excreta. If sanitary landfill or incineration cannot be effected, wastes should be dumped at suitable sites located at least 5 miles from a populated area.

(2) Stockyards and animal yards and shelters should be inspected frequently (at least weekly) to assure proper disposal of excrement. Manure may be held in flyproof bins, spread in thin layers over a field, or buried under 12 inches of compacted earth.

(3) Only sanitary-type privies or latrines should be permitted in areas not served by sewerage systems.

(4) Other potential fly-breeding places, such as abattoirs, food-packing plants, dairies, and stockyards, should practice good housekeeping measures so as not to attract flies and other vermin.

b. Fly control by chemical treatment.—(1) Flies may be controlled by the use of residual spraying of active breeding areas and favored fly-resting surfaces. The basic unit is the one-man area, where effective coverage may be from 20 to 25 city blocks.

(2) Where transportation can be used effectively, the use of power-spraying equipment is desirable. Space-spraying machines can cover from 20 to 30 city blocks per day. Some hand-spraying may be required to reach areas inaccessible to the spray discharged by the machine (inside of outhouses, privies, and buildings).

(3) Insecticides, particularly dieldrin, should not be used in privy pits, since, for some unknown reason, such use causes an increase in fly production.

c. Screening.—The adequate screening of homes, food markets, dairies, hospitals, and similar places serves as a barrier to flies not eliminated by chemical agents. Screens should be provided for all evacuee establishments in all areas.

3. *Rodent control.*—*a.* When actual outbreaks of rodentborne diseases are imminent, certain action should be immediately taken to effect quick emergency control.

(1) Dust ratruns immediately with 10-percent DDT in areas where rats and fleas are numerous.

(2) Extend dusting to other areas in the community where rats and fleas are found.

(3) Conduct mass poisoning of rats at dumps and harborages in proximity to and in the city.

b. Where outbreaks of rodentborne disease are not imminent, the following program is suggested:

(1) A master map should be prepared, with sections outlined where rat-control activities are required. A well-trained specialist should be placed in charge, with sufficient personnel and equipment to meet requirements. The map may be outlined in sections of equally affected work areas, of such size that a single crew can handle poisoning and dusting activities in each work area.

(2) At least one mobile crew should be organized in readiness to institute immediate control

measures, in event a new case of plague or typhus is reported. The premises of the person having the disease should be dusted, and dusting continued in ever-widening circles, using the case person as the center.

(3) The public may be informed by radio of control measures in progress. In case of epidemic, it may be advisable to set up dusting stations to dust individuals with 10-percent DDT.

(4) Reduce rat populations with poison.

(5) Continue dusting operations every few days (at least weekly).

(6) Extend and intensify collection and removal of garbage, rubbish, and debris within 1 mile of the city.

(7) Enforce proper storage of garbage and sanitary disposal methods, to deprive rats of food.

(8) If the city is a port, institute rat-control port regulations.

4. *Other insect-control measures.*—*a.* Roaches and ants may infest kitchens and mess halls in receiving areas. The control of ants and roaches may be effected by good housekeeping practices. A 5-percent chlordane dust or spray, used behind shelves and mopboards, in crevices, under the tops of tables, sinks, stoves, and similar places, will also prove effective in holding these insects in check.

b. Lice, fleas, and mites may be controlled by dusting the hair and inner and outer clothing of individuals with 5-percent DDT powder. Second and third applications should be made at weekly intervals.

c. Fumigation of quarters in camps and shelters should be attempted only by trained personnel.

IV. Unit values for control of vermin

A. *Mosquito control.*

1. *Insecticides.*—Basic chemicals suitable for mosquito control include DDT, BHC (12% gamma isomer), chlordane, and DDD. DDT is the insecticide generally used in residual spraying of houses and space spraying of breeding areas. DDT with sticking agents for house sprayings, BHC, and chlordane are all suitable for the foregoing purposes. Prepared solutions may be purchased commercially or may be prepared as noted below. (The sticking agent should be 2% pine gum rosin.)

a. Solutions.—(1) A *5-percent DDT* (or DDD) kerosene or #2 diesel-oil solution is prepared by dissolving 1 part of technical grade DDT in 19 parts of oil.

(2) A *2½-percent chlordane* solution may be prepared by adding 1 part of 25-percent commercial chlordane (a liquid) in 9 parts of kerosene or #2 diesel oil.

(3) *Velsicol*, for use in power sprayers or airplanes: For a 20-percent solution, dissolve 2.08 pounds DDT in 1 gallon of velsicol NR–70, AR–60, AR–50, or Sovacide 544B.

(4) BHC (12% gamma isomer): A solution of 1 pound in 2 gallons of kerosene or diesel oil, applied per acre of water surface, has been effective for 5 to 8 weeks for anopheline and culicine species of larvae, with no fish damage.

2. *Rate of application.*

a. Residual spray.

(1) *DDT or DDD*—One gallon of 5-percent solution per 1,000 square feet of surface. A special nozzle, producing a flat, fan-type spray, is recommended.

(2) *Chlordane*—One gallon of 2½-percent solution per 1,000 square feet of surface.

b. Space sprays (effective 5 to 10 days).

(1) *DDT or DDD*—Apply at the rate of 1 gallon of 5-percent solution per acre with land equipment, or 1 quart of 25-percent solution per acre by aircraft.

(2) *Chlordane*—Apply at the rate of 1 gallon of 2½-percent solution per acre.

c. Larviciding (repeat at 5- to 10-day intervals).

(1) *DDT* (with hand spray)—a 0.63-percent solution, applied as a mist at the rate of 1 to 3 gallons per acre. (Such a solution is prepared by adding 7 gallons of kerosene or diesel oil to 1 gallon of 5-percent solution; or adding 2½ pounds of DDT, technical grade, to 50 gallons of diesel oil.)

(2) *DDT* (with land-spraying equipment)—a 5-percent solution is applied as a mist or fog at the rate of 0.05 to 0.2 pound of DDT per acre. For use in airplanes, a 20-percent velsicol NR–70 or sovacide 544B solution is applied at the rate of 0.05 to 0.1 pound of DDT per acre.

(3) *Chlordane*, because of higher cost, should be used only when DDT is not available, or where DDT-resistant larvae are encountered. A 0.1-percent solution is applied at the rate of 0.05 to 0.1 pound per acre.

(4) *Others*—new and more effective insecticides are being developed.

B. ***Fly control.***

1. *Insecticides.*

a. Solutions.—(1) *DDT.* Basic insecticide is 5 percent in #2 diesel oil (40 pounds technical DDT in 100 gallons of oil). For outdoor application, 2-percent pine gum rosin may be added as a sticking agent.

(2) *Chlordane* may be used in a 5-percent solution for DDT-resistant flies.

(3) *Lindane*, applied at the rate of 25 milligrams per square foot, may be suitable in dairy barns. (A 0.5-percent solution may be prepared by mixing 4 pounds of 50-percent powder with 50 gallons of water.)

(4) *Methoxychlor.*—A 2.5-percent solution may be applied to walls and ceilings of food establishments and dairy barns.

(5) *Larvicides.*—A 2.5-percent chlordane or a 5.0-percent BHC (12% gamma) solution may be sprayed directly on manure or other excrement to wet the surface, or 5-percent DDT–DMC, if above larvicides are not available. A 7.5:1 ration of DDT:DMC is also suggested for houseflies resistant to several chlorinated hydrocarbons.

(6) Spraying carcasses with 0.5-percent dieldrin, aldrin, or endrin emulsion prevents blowfly infestation for 30 days.

2. *Rate of application.*

a. One-man hand-spray (5-gallon) can.—One man can inspect and apply residual spray or larvicide to surfaces at the rate of 1 to 2 blocks per man-day. Basic (5%-DDT) insecticide should be computed at 20 gallons per block per application. Once-a-month application might be required for a city of 10,000 population. Personnel and equipment include 2,000 gallons of insecticide per month, 4 sprayers, 1 supervisor, 5 spray cans, and 1 pick-up truck.

b. Power-spraying equipment.—Space-spraying machines can cover 20 to 30 blocks per day, will use 120 gallons per day of basic (5%-DDT) insecticide, applied at the rate of 1 gallon per acre or 4 gallons per block. Personnel and equipment include 1 space-spraying machine, 1 truck, 1 truck operator, and 1 spray-machine operator.

c. Airplane spray.—A small airplane, commonly used by crop dusters, can cover 2 square miles per day. Weather, pilot fatigue, and maintenance reduce workdays to about 3 per week. A city of 10,000 will have from 1 to 4 square miles of area. Application rate is 0.4 pound DDT per acre, or 1 gallon of 5-percent DDT in diesel oil.

C. ***Rodent poisons*** (10,000 population city).

1. *Warfarin*, in yellow corn meal or oats. Use 1 part (0.5% of warfarin) to 19 parts of bait for roof rat.

Use 1 part of warfarin to 48 parts of bait for Norway rat. One pound of bait in pie or cake plate, placed in a dry place for 10 days, replenishing bait as necessary.

2. *Other effective baits*, such as 1080, arsenic, and cyanogas, are not recommended for emergency disaster work, unless the program is under the complete supervision of a bonded exterminator.

3. *DDT* (for dusting rat burrows, hollow walls under buildings, etc.). A 10-percent dust, made with talc, powdered clay, chalk, or similar material, may be used for the control of ectoparasites. Dusting may be accomplished by use of 4-pound, hand-plunger type of dustgun for small establishments, or by use of cyanogas in foot-type or hand rotary-blower-type pump.

D. ***Fumigation of premises,*** to effect the control of bedbugs, lice, fleas, and other insects, should be attempted only by responsible persons trained in this field. Here, the sanitarian may well enlist the services of all professional exterminators who can be placed in charge of this work. A number of substances may be safely used, each for a particular purpose; yet, none may be considered an all-purpose fumigant.

1. *Formaldehyde* (HCHO), which is gaseous, is an active germicide, but weak against insects. The gas may be set free in a room by volatilizing tablets of "paraform" over a lamp, using about 30 1-gram tablets per 1,000 cubic feet for 6 hours.

2. *Formalin* is an aqueous solution of formaldehyde. A 2- to 10-percent solution (6 to 8 ounces per gallon of water) may be sprayed on walls, bedding, and similar places.

3. *Sulphur dioxide* is a poor germicide, but is effective against vermin. Roll sulphur may be placed in an iron pot (supported to prevent fire), soaked with alcohol or paraffin, and ignited. Three pounds of sulphur per 1,000 cubic feet of space for 6 hours will be effective. Fabrics will be bleached and metals tarnished by the gas.

4. *Compounds of hydrocyanic acid* are effective. However, they are extremely poisonous to humans and, therefore, may be open to question for emergency use, unless rigidly supervised.

V. Health hazards and precautions

All insecticides suggested for use are, to some degree, toxic to man. Care should be taken by persons preparing pesticides, or applying spray or powder, to avoid breathing the dust and to prevent skin contact, as far as possible. In the application of space or residual sprays, precautions should be taken to guard against spraying insecticides directly on humans, food, food containers, or animal feeds. Insecticides spilled on the body or hands should be removed immediately with soap and water. Avoid inhalation of sprays or fumes. Spray operators should wear protective clothing, such as rubber gloves, broad-brimmed hats, and coveralls. Unusual signs of nervousness, dermatitis, and loss of appetite should be reported immediately, followed by health examinations.

Appendix A

Civil-Defense Planning

PUBLIC WATER SUPPLIES

1. Physical Inventory

Community: ..... 1950 census pop.: .....
Date: ..... Est. present pop.: .....
% metered: .....

A. Est. population served: .....

B. Source of supply: Ground ..... No. of wells: .....
Surface ..... Identify: .....
Max. dependable draft: Ground: ..... MGD
Surface: ..... MGD

C. Treatment (describe briefly):

D. *Chemical usage. *Coagulants* (specify type):
Avg. daily lb./day: .....
Max. monthly lb./day: .....
Chlorine
lb./day: .....
residual maintained: ..... ppm
raw-water chlorine demand: ..... ppm
capacity of each chlorinator: lb./24 hrs. .....

*Supply data only for those chemicals required during an emergency.

E. Treatment plant.
Rated capacity: ..... MGD
Average daily output: ..... MGD
Maximum daily output: ..... MGD
Average daily pumpage: ..... hours/day
Operator on duty: ..... hours/day

F. Manufacturing use: ..... MGD

G. Distribution system.
Elevated storage: ..... MG
All storage covered: .....
If not, describe: .....

Remarks: .....
.....
.....
.....

2. Considerations for Supply During an Emergency

A. Source and Plant

1. Estimated maximum draft from source that could be sustained for a 30-day period: .... MGD
2. Estimated maximum amount of water that could be delivered for a 30-day period with present facilities: ..... MGD
3. What facility is limiting factor in determining amount of water deliverable? (check)
   Treatment plant .....
   Pumps .....
   Distribution system .....
   Other (specify) .....
   Describe zones of minimum pressure on distribution system and indicate pressures during periods of—(a) Minimum consumption: .....
   (b) Maximum consumption: .....
4. Could deliverable water be increased by provision of additional pumps only? Yes ..... No .....
   Estimated possible increase: ..... MGD
5. What improvements in mechanical equipment would be required to permit emergency operation for 30 days at maximum capacity?
   Give brief details if one or more of the following are required:
   Minor overhaul:
   Major overhaul:
   Replacement:
6. In case of failure of normal source, is electric power available from alternate source? Yes .... No ..... Normal available power: .... kw. Power available from alternate source: .... kw.
7. *Standby pumping.*

	Source	*Ground Storage*
Capacity:	..... MGD	..... MGD
Type fuel:	.....	.....

   Fuel normally available for .... hours operation. Is additional fuel readily available? Yes ..... No .....

B. Water Use.

1. With elimination of lawn watering, street flushing, air conditioning, etc., what would be estimated reduction in average water use? ..... MGD.
2. Estimated manufacturing use under emergency conditions ..... MGD.

C. Operational.

1. Is a mutual-aid agreement in effect with another community under which supplies and equipment are available in case of emergency? Yes .... No .....
   If so, detail briefly:

2. Which chemicals normally in use could be dispensed with, if necessary, during an emergency?
   .....
   .....
   What changes in plant operation would this require? .....
   .....
3. Which chemicals normally in use would be required during an emergency? .....
   .....
   What is present source of such chemicals (city) and approximate delivery time? .....
   .....
   How many days' supply normally on hand? (Show number of days for each essential chemical.).....

4. What are normal personnel requirements and those anticipated under emergency conditions?

	Normal	*Emergency*
Superintendents:	.....	.....
Plant operators:	.....	.....
Maintenance men:		
Plant:	.....	.....
Dist. system:	.....	.....
Source:	.....	.....

How will additional personnel requirements be met? .....
.....

5. Would it be feasible to shut off water supply entirely and deliver water only at stipulated times? Yes . . . No . . . .
How would this be done? .....
Has this ever been done? Yes ..... No ..... For how long was supply shut down? .....
Were any complications met with? Yes ..... No ..... If so, describe briefly: .....
.....

6. What types of water-supply equipment are normally on hand, such as pumps, pump parts, pipe, etc.? .....
.....

D. Auxiliary Supplies.

1. Are there any developed water supplies that could be used as an adjunct to the city system in case of emergency? Yes ..... No ..... If so, describe briefly: .....
.....
2. What is estimated quantity of water that could be obtained from these supplies? .....
..... MGD
3. What improvements would be required so that these supplies could safely be used as emergency water sources? .....
.....

EMERGENCY WATER-SUPPLY SOURCES BEYOND AREAS SERVED BY MUNICIPAL WATER SYSTEMS

Existing Supplies:

1. Farms.
   - *a.* Average number of farm wells per square mile: .....
   - *b.* Average depth: .....
   - *c.* Type of pumping equipment in general use: .....
   - *d.* Type of power and standby equipment: .....
   - *e.* Capacity: .....GPM
2. School Supplies. Describe: .....
.....
3. Canneries, milk plants, beverage plants, etc. Describe each and give capacity and pumping equipment: .....
.....

Emergency Sources of Water (suitable as source for emergency filter plant):

1. Location: .....
2. Quality: .....
3. Quantity: .....

Fluid Milk Supply—Pasteurization Plants:

1. Location of each: .....
2. Normal output, gal./day: .. ..

3. Maximum capacity, gal./day: .....
4. Source of power: ..... Emergency source: .....
5. Type of heat: .....
6. Capacity of well: ..... GPM

EXCRETA DISPOSAL

Type of sewers..... Separate:.....; Combined:.....

Est. pop. served:

By sewers..... By trt. plant:.....

Adequacy of sewers:

Describe areas where sewers flood basements in heavy rain. Describe areas where sewers approach capacity flow in—

(*a*) Wet weather:.....

(*b*) Dry weather:.....

Treatment plant:

Type of treatment: None ..... Primary.....

Int..... Secondary.....

List main units:

Avg. daily flow:.....MGD

Design flow:.....MGD

Max. possible flow that could be handled:.....MGD

Limiting unit:.....

Significant amount of industrial waste?

Yes..... No..... % of total flow: .....

Can plant be bypassed?

All flow.....

Part of flow.....

No.....

Population equivalent raw sewage: .....

Population equivalent discharged waste:.....

Discharge to:.....

Standby power:

Pumping stations. List for each station:

Type power:

Maximum pumpage with standby power:

Treatment plant.

Type power:

Maximum pumpage with standby power:

Stream below plant:

Avg. flow:.....

Min. flow:.....

Used for water-supply source:.....

Other uses:.....

What are normal personnel requirements and those anticipated under emergency conditions?

	Normal	*Emergency*
Superintendents:	.....	.....
Plant operators:	.....	.....
Maintenance men:		
Plant:	.....	.....
Dist. system:	.....	.....
Source:	.....	.....

How will additional personnel requirements be met?

INSECT AND RODENT CONTROL

1. Vectorborne diseases endemic to area:

Disease	*Vectors*
.....	.....
.....	.....
.....	.....
.....	.....

2. Details of community program:
   - Personnel:
   - Insecticides and/or rodenticides used:
   - Source of supply:
   - Spraying equipment.
     - Hand:.....
     - Power:.....
   - Other required equipment:.....
   - Additional remarks:.....
3. Estimated personnel needs during emergency:
   - Administrative:.....
   - Supervisory:.....
   - Maintenance:.....
   - Labor:.....

   To what extent could these needs be met by private concerns in the community?
4. Control measures required:
   - A. .....
   - B. .....
   - C. .....
   - D. .....

REFUSE MANAGEMENT

1. Is refuse separated for collection? Yes ..... No.....

   Garbage — Rubbish — Noncombustible

   Ashes — Combustible
2. Collection frequency:

   Annual refuse production:

   Domestic: Tons Cu. Yd.

   Business:
3. Number and size of collection vehicles:
   - Operated by municipality:
   - Operated by contract:
   - Operated privately:
4. Method of disposal:

   Incineration..... Open dump.....

   Sanitary landfill..... Hogfeeding.....

   Other.....
5. Personnel:

	Adm.		*Supervisory*		*Drivers*		*Laborers*	
	Pres.	*Emg.*	*Pres.*	*Emg.*	*Pres.*	*Emg.*	*Pres.*	*Emg.*
Municipality:.....	.....		.....		.....		.....	
Contractor:.....	.....		.....		.....		.....	
Private:.....	.....		.....		.....		.....	

6. Major equipment need in disposal process (cranes, bulldozers, tractors, trucks, etc.):

   Type:..... Number:.....

U. S. GOVERNMENT PRINTING OFFICE: 1957